ARADO

Following on from the unsuccessful E.580, the Arado design bureau at Landeshut in Silesia began development of a fighter incorporating the latest in aerodynamic technology. Initial work on Project E.581 dated back to November 1944. Featuring a typically Arado wing planform designed specifically for high speed flight it was originally intended for the aircraft to be powered by the BMW 003 turbojet then in production. The reasoning for this decision is not clear, other than perhaps the desire to get an aircraft built and into the air as quickly as possible. Nor is it known whether Arado was undertaking this work on its own initiative or in response to an official contract from Berlin.

Professor Walter Blume's team based their aerodynamic concept on, among others, the E.555 long range bomber, of which there were no fewer than 14 development studies. Most of these depicted an aircraft characterised by a short span wing with reduced outboard sweep.

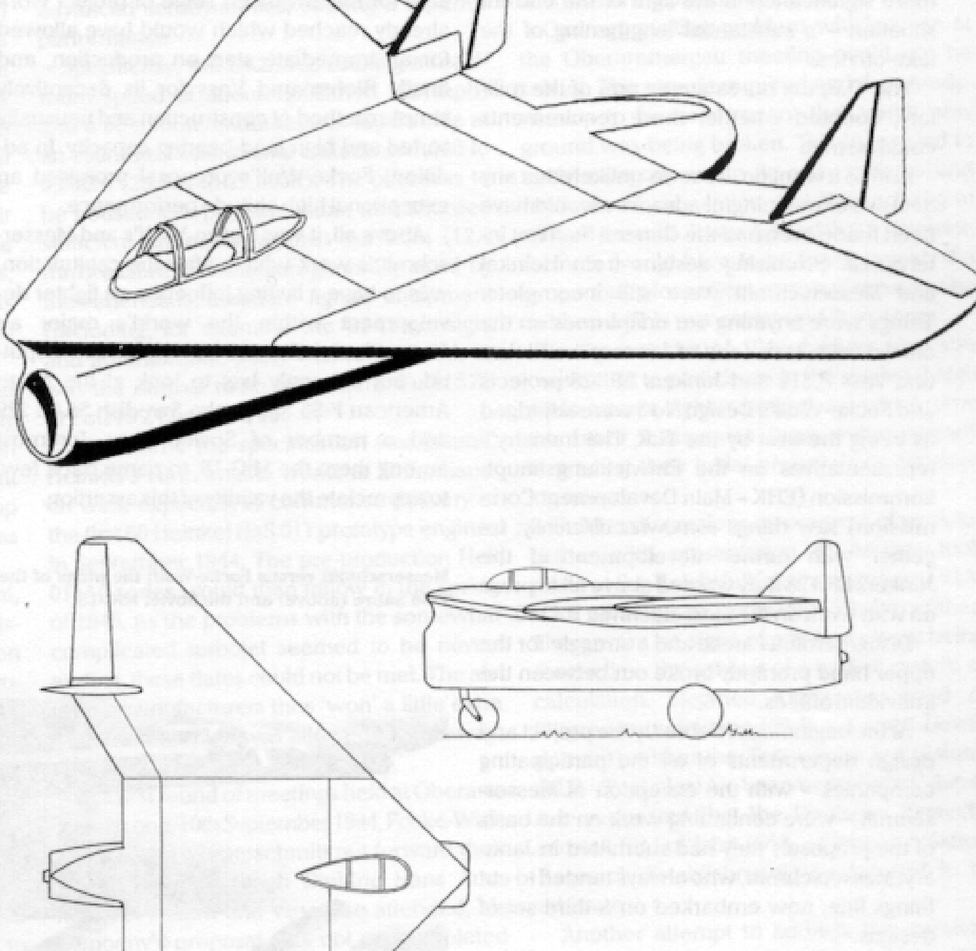
The abandonment of the long range bomber project at the end of November 1944 released additional capacity for the development of the fighter. At the beginning of 1945 Arado adapted their E.581 design to conform to the on-going specifications for the high performance fighter powered by the HeS 011.

Arado E.581-5

January 1945

Relatively little is known of the E.581-1, '581-2 and '581-3 studies. But of the somewhat larger E 581-4 and '581-5 proposals – which differed only in detail – general arrangement drawings, weight tables, and sketches have survived.

Arado obviously ceased work on this design after the Luftwaffe issued its new requirements and concentrated instead on further development of the Ar 234 and their plans for the night fighter of the future.



Powerplant

One Heinkel HeS 011 turbojet rated at 1,300kP (2,865lb) static thrust.

Dimensions

(E.581-4 and E 581-5)

Span	8.95m	29ft 2⅜in
Sweep	45° at leading edge	
Wing area	24.5m²	263ft²
Aspect ratio	3.27 : 1	
Length overall	5.65m	18ft 6in
Height overall	2.60m	8ft 6in

Weights

Empty equipped	2,454kg	5,410lb
Loaded	3,734kg with 1,400kg (1,250litres) of fuel	8,231lb with 3,086lb (274 galls) of fuel
Max wing loading	152.4kg/m²	31.2lb/ft²

Performance

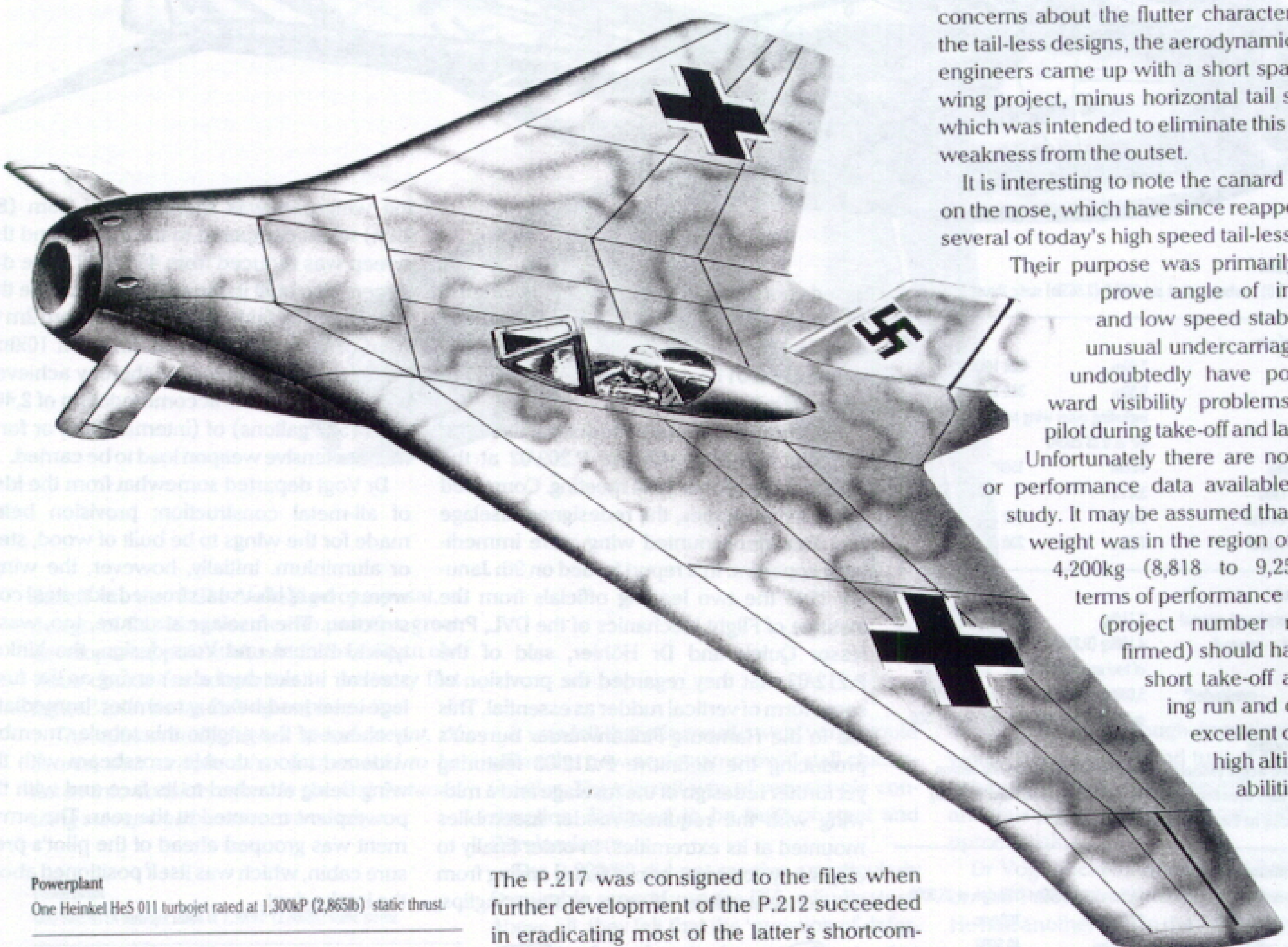
No data are available. The inherent danger of duct loss from the long intake and, above all, the large surface areas with their various corners and edges would seem to indicate insufficient high speed performance. On the other hand, the low wing loading figure points to manoeuvrability and good climb and high altitude characteristics. Take-off and landing speeds should also have been superior to those of its competitors. Fuel capacity would not have sufficed for the endurance required.

Armament

Two 30mm MK 108 cannon in wing roots.

Blohm und Voss Ae 607/P.217

February 1945



When the DVL adjudicators began voicing concerns about the flutter characteristics of the tail-less designs, the aerodynamicists and engineers came up with a short span swept wing project, minus horizontal tail surfaces, which was intended to eliminate this possible weakness from the outset.

It is interesting to note the canard winglets on the nose, which have since reappeared on several of today's high speed tail-less aircraft. Their purpose was primarily to improve angle of incidence and low speed stability. The unusual undercarriage would undoubtedly have posed forward visibility problems for the pilot during take-off and landing.

Unfortunately there are no weights or performance data available for this study. It may be assumed that take-off weight was in the region of 4,000 to 4,200kg (8,818 to 9,259lb). In terms of performance the P.217 (project number not confirmed) should have had a short take-off and landing run and displayed excellent climb and high altitude capabilities.

The P.217 was consigned to the files when further development of the P.212 succeeded in eradicating most of the latter's shortcomings.

Powerplant

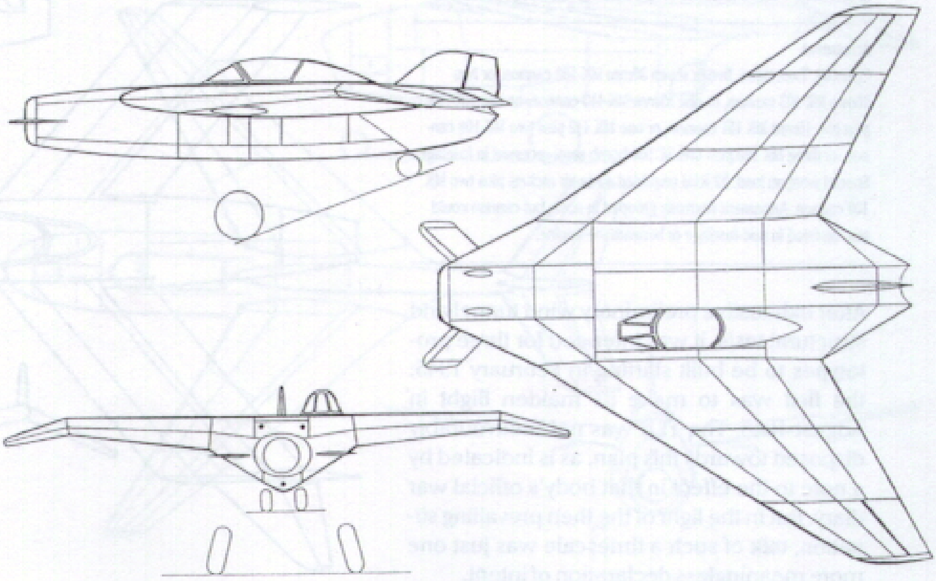
One Heinkel HeS 011 turbojet rated at 1,300kP (2,865lb) static thrust.

Dimensions

Span	8.00m	26ft 3½in
Sweep	45° at 0.5 chord	
Wing area	26.0m²	280ft²
Aspect ratio	2.46 : 1	
Length overall	7.05m	23ft 2in
Height overall	2.90m	9ft 6in

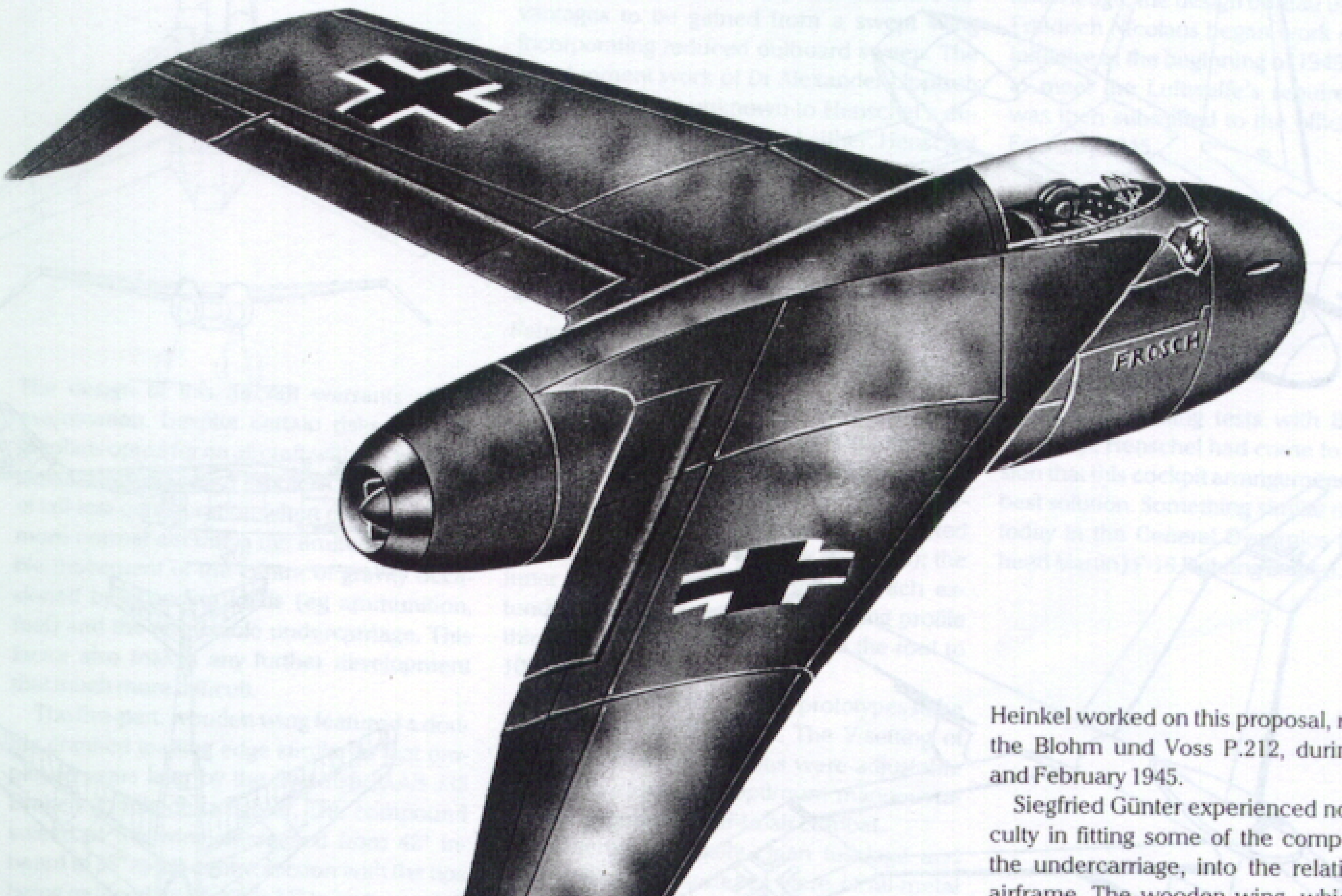
Armament

Three 30mm MK 108 cannon in forward fuselage.



Heinkel P.1078

February 1944



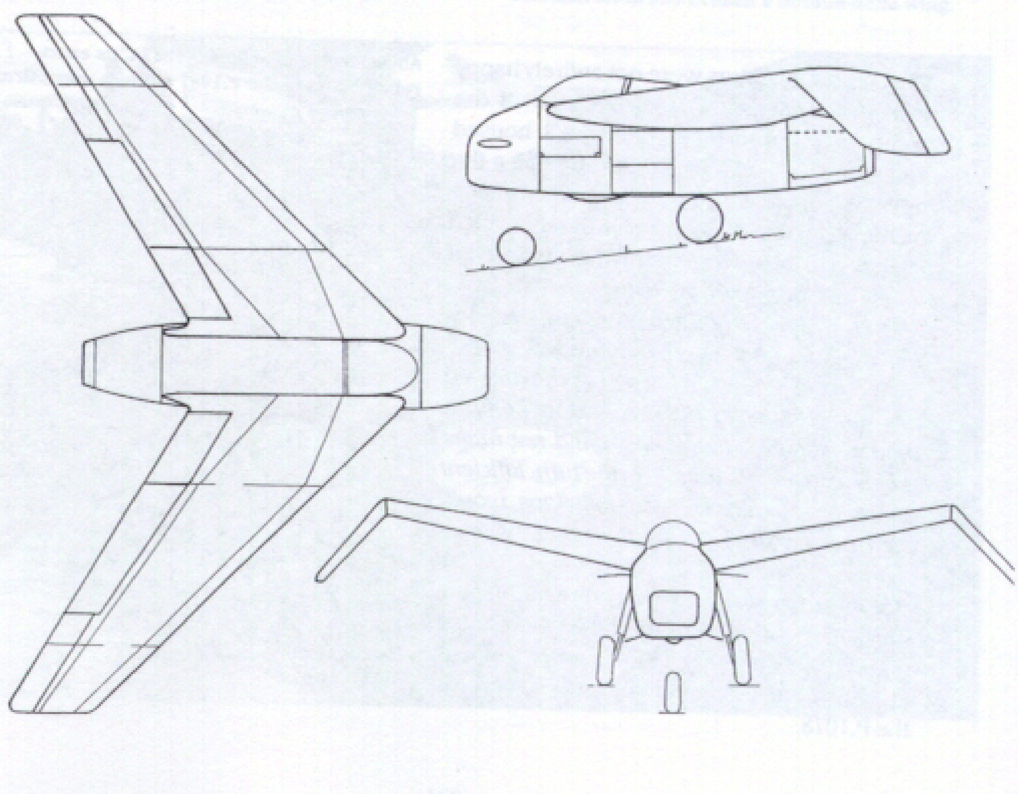
Heinkel worked on this proposal, resembling the Blohm und Voss P.212, during January and February 1945.

Siegfried Günter experienced no little difficulty in fitting some of the components, eg the undercarriage, into the relatively small airframe. The wooden wing, which accommodated the entire fuel load, was mated to an all-metal fuselage.

Powerplant

One Heinkel HeS 011 turbojet rated at 1,300kP (2,865lb) static thrust.

Dimensions		
Span	9.00m	29ft 6in
Sweep	40° at 0.25 chord	
Wing area	17.8m²	191ft²
Aspect ratio	4.55 : 1	
Length overall	6.10m	20ft 0in
Height overall	2.35m	7ft 8in
Weights		
Empty equipped	2,454kg	5,410lb
Loaded	3,920kg with 1,200kg of fuel	8,641lb with 2,645lb of fuel
Max wing loading	220kg/m²	45lb/ft²
Performance		
Max speed	1,050km/h at 7,000m	652mph at 23,000ft
Initial rate of climb	29.8m/sec	98ft/sec
Take-off run	700m	2,296ft
Landing speed	182km/h	113mph



Horten Ho X (Ho XIIIb)

1944/45

Work on this scheme began with the construction of free-flying models, each weighing 8-10kg (17-22lb) and featuring a sharply swept wing of some 3m (9ft 9½in) span. These were then used to carry out the first practical flight tests in Göttingen.

In 1943, in order to gain quick results from a manned aircraft, the small company used their Ho IIIb flying-wing glider as the basis to build an experimental glider incorporating 60° leading edge sweep. For camouflage purposes, and to disguise any connection to work on the Ho X fighter, this 12.4m (40ft) wingspan aircraft was given the designation Ho XIIIa. Further work on the supersonic delta continued under the designation of Ho XIIIb. Flight tests with the Ho XIIIa commenced with the first flight on 27th November 1944 and were only terminated by the ending of the war. During that time 20 flights, totalling some ten hours, provided valuable information on the slow speed flight characteristics of the sharply swept flying-wing planform.

Details as to the final layout of the supersonic delta are contradictory. The British Royal Aircraft Establishment Report FA.259/1 of October 1945, for example, states that:

In appearance the Horten X resembles the Lippisch designs for high speed and supersonic aircraft, especially the P.13. Horten declared that he had not known anything of Lippisch's work until arriving in London.

The major difference in the design lies in the fact that Horten regarded a special vertical surface as unnecessary, whereas Lippisch favoured a very large vertical rudder assembly.

It is possible that this last sentence does not refer specifically to the Horten Ho X, but rather to the design philosophy as a whole. In the 1982 book *Flying-Wing, the Story of Horten Aircraft 1933-1960* Reimar Horten himself remarks:

With a half span of only 3.6m and a length of 10m, aerodynamic rudders were no longer sufficient. The Ho X (XIIIb) was therefore equipped with a keelfin from the start. Furthermore, in the trans-sonic flight range an aerodynamic rudder would generate shock waves on the wing's upper surface.

In further work on supersonic aircraft carried out in Argentina in 1953, Reimar Horten and his then colleague, Dr Karl Nickel, also made provision for a relatively large rudder assembly from the outset.

Illustrations of the Ho X and Ho XIIIb often appear in literature. But these do not resemble the descriptions given by Reimar Horten in the above-mentioned book. Using this source, and with the aid of the British report already quoted, which also includes an illustration, an attempt has been made to reconstruct the aircraft. All drawings, calculations and other documentation were presumably lost in the final days of the war.

In 1945 a wooden glider version was under construction, parts of which were found by the British after the capitulation. In a second phase of the development this glider was to have been motorised by fitting an Argus As 10c engine. Only after thorough tests at up to 500km/h (310mph) was the proposed HeS 011-powered supersonic fighter to have been built. This step-by-step procedure adopted by the Horten works was similar to that followed during their development of the earlier Ho IX. From this it is clear that the gestation period of the Ho X would certainly have required several years.

Together with the work of Dr Lippisch, this aircraft represents the first steps on the road to the modern high speed, jet-powered delta-winged aircraft of today. Many years after the war the British tested an aerodynamic concept closely resembling the Horten design with their Handley Page HP.115. The data gathered in subsonic flight by this short span delta with a leading edge sweep of almost 70° was incorporated in the Anglo-French Concorde supersonic transport programme.

Crew

Pilot in prone position in cockpit with slightly curved Plexiglas canopy faired into wing contour.

Powerplant

One Heinkel HeS 011A-0 rated at 1,300kP (2,865lb) static thrust; later a more powerful version with 1,500kP (3,306lb) static thrust; provision for additional rocket booster.

Dimensions		
Span	7.20m	23ft 7in
Sweep	Delta with 70° leading edge	
Wing area	37.8m²	406ft²
Aspect ratio	1.37 : 1	
Profile thickness	7%	
Length overall	10.0m	32ft 9½in
Height overall (approx)	4.20m	13ft 8in
Weights		
Take-off	6,000-7,000kg	13,227-15,432lb
Max wing loading	160-185kg/m²	32.7-37.8lb/ft²
Performance		
Max speed	1,200km/h at 6,000m (M= 1.07)	745mph at 19,750ft
Service ceiling	15,000m	49,000ft
Range	2,000km	1,242 miles

Armament

Three or four 30mm MK 108, or three or four 30mm MK 213C cannon.

The Ho XIIIb as represented in post-war literature.

LIPPISCH

Dr Alexander Lippisch was an eminent man of science and extraordinarily gifted designer, and like the Horten brothers, occupies a special place in this survey of German aviation projects. He had at his disposal what was, in effect, his own large aircraft works where his revolutionary ideas, studies and designs – all far ahead of their time – could be realised. Touched by a genius which could at times be decidedly impetuous, he was always dependent on collaboration with established aircraft manufacturers, an arrangement which was not without its complications and which did not always run smoothly. After all, each of these manufacturers had their own ideas, development programmes and chief designers who did not, indeed should not, want to be made to feel inferior to Lippisch and his work.

It was not until he moved to Vienna that he was given his own works with a staff of 110. This factory had previously produced water heaters, and the only knowledge of aircraft manufacturing it possessed was purely from hearsay. The conversion to the building of wooden aircraft was particularly difficult, as almost all of the necessary machinery was lacking. By the end of the war, apart from a few models, they had succeeded in producing just the centre fuselage section of the Delta VI V1.

After more than four years of collaboration with the Messerschmitt company at Augsburg – years marked with successes, but also with jealousies and petty intrigues – Dr Lippisch became head of the Luftfahrtforschungsanstalt (LFA – Aviation Research Institute) in Vienna, which was part of the LFA Munich-Ottobrunn organisation.

During his time with Messerschmitt, apart from the Me 163, Lippisch had been responsible for a wide range of designs intended for the most diverse of purposes and roles. The studies into jet fighters which he carried out there during the early war years are covered in some detail as these clearly document the very beginnings, the first tentative steps, towards today's modern single-jet fighters. While so doing, Lippisch had anticipated much which would not become common knowledge and practice in aviation technology until many years later. Even at the end of the war, his was still a progressive influence at Messerschmitt; as witness the Enzian surface-to-air missile, the P.1111 and P.1112 tailless fighter designs and the projected P.1108 long range bomber.

In Vienna he concentrated more and more on new wing forms and new methods of propulsion. He broke new ground with his work, begun in the 1920s, on the delta wing and with his studies in the field of ram jet engines, in particular of new types of combustion chambers and the use of solid fuels.

In addition to this pioneering research work, which he backed up with wind tunnel tests and flight trials using models, there was also a whole range of projects which could be realised fairly quickly and which Lippisch wanted to build in experimental and operational form in collaboration with other manufacturers such as Henschel. Examples of the latter were the ram jet-powered P.13a and 'b, and the twin-jet Delta VI fighter, whose performance was superior to that of the Me 262 but which was constructed of 'non-essential' tubular steel and plywood.

One last observation regarding the designations used by Lippisch. At Messerschmitt he began with Project (P).01 and ended with P.20. He retained most of these designations after the move to LFA in Vienna, but renumbered a few and altered the original design or role of others several times. In Augsburg, for example, his design in competition to the Do 335 was designated P.13. Later, in Vienna, he used P.13 to identify the ram jet-powered fighter mentioned above. Work on the P.11 fast jet bomber was also begun at Messerschmitt, was initially continued as such at LFA in Vienna, but then formed the basis for a fighter which, referring back to even earlier work, was finally designated 'Delta VI'. This represented an almost completely new aircraft when compared to the original. Examples such as these can, and have, led to a certain amount of understandable confusion.

Lippisch Project P.01

In January 1939 Alexander Lippisch and his team had left the Deutsches Forschungsinstitut für Segelflug (DFS – German Research Institute for Sailplanes) at Darmstadt to go to Messerschmitt at Augsburg. There, backed by the industrial giant and on behalf of the RLM, he was to work on a project for a tail-less experimental aircraft to be powered by the new-style rocket engine. Upon the outbreak of war, however, the Ministry withdrew the bulk of its support for the futuristic 'Projekt X' aircraft which, for reasons of secrecy, was given the RLM number 8-163; a number which had already been allocated to another Messerschmitt design intended as a competitor to the Fieseler Fi 156 Storch liaison aircraft.

Lippisch, who had foreseen this development, therefore turned his mind, in keeping with the times, towards a military application for his project. From the designs of April 1939 there thus emerged an interceptor fighter which, after the successful flights of the DFS 194 experimental aircraft and the considerably more advanced Me 163A, again found wide support from the RLM. The end result of all these endeavours was the emergence of the now familiar operational Me 163B Komet. (Pure rocket-propelled fighters are a study in their own right and are dealt with in this book only when they relate to turbojet or mixed-powerplant developments.)

Back in 1939, and with some justification, Lippisch did not entirely trust the new rocket engine, which was then still under development and suffering all sorts of problems. He therefore kept all his options open with regards to the powerplant of his proposed operational fighter, not wishing to see the whole project brought to a halt should – as seemed quite likely – the rocket engine prove a complete failure. So, in addition to the rocket-powered P.01 proposals, he produced a number of designs to be powered by the equally new turbojet engine, of which no operational examples – it must be admitted – existed either. Nonetheless, Lippisch's work was distinguished, above all, by its combination of a new form of propulsion allied to new